CURRENT LITERATURE

NOTES FOR STUDENTS

Applied ecology.—Increasing attention is being paid to the application of ecological principles to problems in plant and animal agriculture, horticulture, and forestry. Among the more important recent papers in this field are three contributions by SAMPSON,[1] and one by SAMPSON in conjunction with WEYL.[2] The first of these is an attempt to show a correlation between climate, vegetative associations, and crop production. Stations for instrumental work were established in the Manti National Forest of Utah at three different elevations, one in the oak-brush association which ranges from 6500 to 7800 ft. in altitude, a second in the aspen-fir association which ranges from 7500 to 9500 ft., and a third in the spruce-fir association which ranges from 9000 to 11,000 ft. The plants used in the experiments were field peas, Kubanka wheat, and the mountain brome grass (*Bromus marginatus*). Measurement was made of transpiration, wind velocity, temperature, rainfall, evaporation, sunshine, and barometric pressure, and comparisons were made with plant growth and water requirement. The number of growing days varies from 120 at the lowest to 70 days at the highest station. The greatest rainfall is at the middle station, being about twice that of the station below. The evaporation is greatest at the lowest station, but is almost as great at the highest station, owing to wind velocity. The necessary effective heat units for wheat and field peas exist only at the lowest station, where the water supply is inadequate unless supplied artificially.

SAMPSON's paper on plant succession in relation to range management is a peculiarly apt illustration of the importance of ecological principles in the treatment of range lands. To most agriculturists it would seem a far cry from an academic study of plant succession to the practical treatment of range land and pasture, but SAMPSON makes it very clear that the relation between the two is fundamental. Stockmen have generally recognized that overgrazing is a common result of their practice, but they have for the most part been unable to detect overgrazing in time to stop the damage. SAMPSON has

[1] SAMPSON, ARTHUR W., Climate and plant growth in certain vegetative associations. Bull. 700, U.S. Dept. Agric. pp. 72. *figs. 37.* 1918.

———, Plant succession in relation to range management. Bull. 791, U.S. Dept. Agric. pp. 76. *pls. 2. figs. 26.* 1919.

———, Effect of grazing upon aspen reproduction. Bull. 741, U.S. Dept. Agric. pp. 29. *pls. 5. figs. 7.* 1919.

[2] ———, and WEYL, L. H., Range preservation and its relation to erosion control on western grazing lands. Bull. 675, U.S. Dept. Agric. pp. 35. *pls 6. figs. 8.* 1918.

shown that grazing results in retrogression, the more stable or climax forms being gradually eliminated and their place being taken by plants characteristic of more primitive successions. The key to the situation, therefore, is the invasion of the more stable or climax formations by relatively pioneer forms. If such invasion is detected in time, grazing may be reduced or wholly abandoned for a time, thus giving the more desirable species characteristic of the higher successional stages an opportunity to reestablish themselves. The region under consideration in this paper is the neighborhood of the Great Basin Experiment Station in the Manti National Forest. Here four major successional stages are recognized: the first or early weed stage, characterized by ruderals; the second or late weed stage, with foxglove (*Pentstemon procerus*), sweet sage (*Artemisia discolor*), and yarrow (*Achillea lanulosa*) as leading species; the mixed grass and weed stage, with porcupine grass (*Stipa minor*) and yellow brush (*Chrysothamnus lanceolatus*) dominant; and the subclimax or wheat-grass (*Agropyron* spp.) stage. The wheat-grasses constitute the climax herbaceous cover and are desirable range grasses. Overgrazing nduces the appearance of species characteristic of the next lower stage, and continued overgrazing may even result in the appearance of the more primitive weed stages. The most representative indicator of retrograding wheat-grass land is *Chrysothamnus*. The *Stipa-Chrysothamnus* stage is equal or slightly superior to the *Agropyron* stage for range land purposes. Retrogression to the *Pentstemon-Artemisia-Achillea* stage is distinctly undesirable, although sheep do well here. Retrogression to the first or ruderal stage may be disastrous. If grazing is permitted here, all vegetation may disappear and finally the soil itself, through the action of erosion, in which event recovery is difficult or even impossible. In the treatment of the different vegetational stages, the writer considers in detail the conditions of growth and reproduction, the soil water content, the root relations of the characteristic species, the effect of disturbing factors, palatability, and forage production. All-in-all this is one of the most important papers in the field of applied ecology, and may well serve as a model to investigators everywhere.

The studies resulting in SAMPSON's paper on the effect of grazing on aspen reproduction were also carried on in the Manti National Forest. This paper recommends that an attempt be made to work out a proper balance between the production of meat and timber. As the aspen does not reproduce effectively in its own shade, it is recommended that the timber be cleancut, and that the new growth be exempted from grazing or be grazed moderately by cattle rather than by sheep, which are much more destructive. When the new shoots reach a height of 45 inches (which results generally in about three years), they are effectively out of the reach of sheep, so that from then on to timber maturity grazing by sheep may be permitted.

Another paper resulting from studies in the Manti National Forest is the one by SAMPSON and WEYL on range preservation and erosion control. Overgrazing in this region, especially by sheep, has resulted in such a serious destruction of the vegetation carpet as to have given rise to further and more serious loss through erosion. The peak of this destruction has been in the spruce-fir basins, above 9000 ft., where slopes are steep and summer grazing is excellent. Deferred and rotation grazing are necessary to prevent the destruction of these areas for grazing purposes; once erosion has set in, grazing should be abandoned, and an attempt made to re-create good grazing conditions by terracing, planting, and the construction of dams.

In connection with these bulletins there may be mentioned one on the general principles underlying range management in the National Forests,[3] in which such topics are considered as the determination of the class of stock to which the range is best suited, grazing periods, grazing capacity, management of cattle on the range, management of sheep on the range, range reseeding, and timber protection. Very full lists of references are given.

The ecological study of pastures has been taken up also in foreign lands. The work of BEWS in South Africa has already been noted in these pages.[4] An interesting study of Scottish hill pastures has been made by SMITH.[5] A hill pasture is defined as an area that is uninclosed and unploughed. Sixty per cent of the area of Scotland, or 18,000 square miles, comes under this category, although much of this is unsuitable for grazing. The different plant associations of these lands are mentioned and characterized, and it is clearly brought out that each association represents a particular combination of climate, soil, and grazing animals. The improvement of pasture land is based on the fundamental principle that the herbage changes as the growth conditions change. The foundation of hill pasturage is in the alluvial and flush grasslands, where the vegetation is rich and palatable; these areas may be extended by irrigation, diversion of surface water, and drainage. Bracken (*Pteris aquilina*) land is flush grassland with a luxuriant growth of the bracken. This land makes excellent pasturage if the bracken is removed by cutting or by spraying with 5 per cent sulphuric acid. Heather (*Calluna*) land is valuable for sheep grazing, but it should be burned over every few years, to stimulate the increased development of palatable green shoots. Peaty lands may be improved by drainage or burning. Considerable areas are characterized by rough grasses of low grazing value, notable among which are *Nardus stricta* and *Molinia coerulea*. It is desirable to replace these by finer herbage, by flushing, or by diverting surface water.

Quite another sort of applied ecology is represented in a paper by COKER[6] on pisciculture. Plants are the chief oxygenators in confined ponds, and are

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[3] JARDINE, JAMES T., and ANDERSON, MARK, Range management on the National Forests. Bull. 790, U.S. Dept. Agric. pp. 98. *pls. 32. figs. 4.* 1919.

[4] BOT. GAZ. 67:370. 1919.

[5] SMITH, W. G., The improvement of hill pasture. Reprint from Scottish Jour. Agric. pp. 8. 1918.

[6] COKER, R. E., Principles and problems of fish culture in ponds. Scientific Monthly 7:120–129. *figs. 2.* 1918.

therefore of fundamental importance in fish culture. Although little is known yet as to which plant species are best for oxygenation, it is probable that evergreen species with finely divided leaves are the most satisfactory. It has long been known, of course, that plants are the basis of all fish food, but we are only just beginning to determine which species have the greater food values. Another thing of importance is the determination of the optimum association of species in a pond.—H. C. Cowles.

Cytology of Synchytrium and Urophlyctis.—Within a year considerable light has been shed on the puzzling problems of cytomorphology in the Chytridiales by reinvestigations of *Synchytrium* (*Chrysophlyctis*) *endobioticum* and *Urophlyctis alfalfae*. The careful and thorough studies of Miss Curtis[7] on *Synchytrium* and of Jones and Drechsler[8] on *Urophlyctis* deserve particular notice. The most noteworthy results of Miss Curtis' study of *Synchytrium* are the establishment of the occurrence of gametic fusions in the life cycle and the demonstration that a prosorus is regularly antecedent to the development of the sporangial sorus, the contents of this body passing into the host cell where segmentation into sporangia and production of zoospores take place. During the development of the prosorus from the infecting zoospore a series of nucleolar discharges of chromatin occurs, and the five chromosomes originate also from the nucleolus; but all divisions from the primary nucleus to the zoospore primordia are typically mitotic. The asexual or sexual nature of the motile cells terminating this series appears to depend on the availability or lack of water during maturation; if water becomes tardily available simultaneous germination of a number of sporangia occurs and their zoospores pair, probably exogamously. Unpaired zoospores and zygotes penetrate growing parts of potato plants; the former reproduce the prosorus phase, but the zygotes develop into resting sporangia. In the production of the latter no form of mitotic division was observed. Chromatic granules appear in the cytoplasm following nucleolar discharges, and after a further loss of chromatin (a process homologized with reduction) the granules become zoospore primordia. The existence of sexual fusions between facultative gametes is hypothecated for all Synchytriaceae which produce true resting spores. The validity of *Chrysophlyctis* is rejected, and the writer prefers the broader generic name *Synchytrium* to *Pycnochytrium*, to which the organism in all respects conforms.

The absence of mitosis in the development of the resting sporangium and the conception of nucleolar gemmation taking the place of meiotic divisions

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[7] Curtis, K. M., The life history and cytology of *Synchytrium endobioticum* (Schilb.) Perc., the cause of wart disease in potato. Phil. Trans. Roy. Soc. London. B **210**:409–478. *pls. 12–16*. 1921.

[8] Jones, F. R., and Drechsler, Charles, Crown wart of alfalfa caused by *Urophlyctis alfalfae*. Jour. Agric. Res. **20**:295–324. *pls. 47–56*. 1920.